MIE334: Numerical Methods

Assignment 4

Due: **April 13th**, **11:59 pm**, 2021

1. Consider steam condensing on the outside of a heat exchanger tube in which water is flowing. If the following equation describes the variation of the temperature of the water as it flows through the heat exchanger tube at steady-state conditions:

$$v\frac{dT}{dx} = \frac{4h}{\rho C_p D}(T_s - T)$$

with the following condition at the inlet of the tube: $T(0) = 24\ ^{o}C$

where v is the average velocity of the water stream ($1.5\ m/s$), T is the temperature of the water stream (^{o}C), x is the distance down the heat exchanger tube from the entrance (m), h is the heat transfer coefficient ($1{,}000\ W/m^2 \cdot {}^{o}C$), ρ is the density of water ($1{,}000\ kg/m^3$), C_p is the heat capacity of water ($4181\ J/kg \cdot {}^{o}C$), D is the inside diameter of the tube ($22\ mm$) and T_s is the temperature of the condensing steam ($120\ ^{o}C$). If the length of the heat exchanger tube is $20\ m$, use Euler's Method (with a step size of $4\ m$) to determine the outlet water temperature.

(You need to show the equations that you used for your calculations. You should also show your calculation in each step. You can show them in a table if you use excel or MATLAB to solve the question).

2. For the given function below, first calculate the integral analytically and then use both Gauss quadrature and multi-segment trapezoid with various number of Gauss points and number of segments, respectively until you get an error of less than 10%. (error is defined between the calculated integral by the method and the analytical solution)

$$I = \int_0^{3\pi} sin(x)dx = ?$$

If you use MATLAB, or excel to solve the question, you can copy the text of your MATLAB code, or the screen shot of your excel file as your detailed solution. Also, report the final answers in the tables (like the tables below). Comment on the number of operations that is required for each method to get an error of less than 10%.

Number of segments	I_trap	Error (%)
1		
2		
….		

Number of Gauss points	I_gauss	Error (%)
1		
2		
….		